

# SYSTEMS INTEGRATION STRATEGIES FOR THE 10-kWh REDFLOW ZINC BROMINE BATTERY MODULE

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## INTRODUCTION

Modern energy storage systems are most credibly demonstrated in field applications.

Over the past three years, RedFlow has deployed its commercial flow battery, the 10-kWh zinc bromine module (ZBM), in progressively more sophisticated and reliable packaged energy storage systems. In doing so, RedFlow has embedded its ZBM in systems constructed with contemporary (commercial) power electronics.

These devices (commercial inverters and rectifiers) are designed to support Battery Management Systems (BMSs) for lead-acid (LA) battery characteristics. RedFlow's system integration engineers have progressively adopted these products and, with some assistance from the relevant manufacturers, have developed strong and reliable packaged energy storage systems based on ZBMs.

This paper reviews the evolution of this product strategy through four products deployed by RedFlow in both grid-connected and off-grid applications.

The reference design is a system based on a 48-volt LA battery bank grid tied with an inverter/rectifier. All of the systems presented incorporate the SMA brand Sunny Backup or Sunny Island devices (the latter for off-grid) and in sequence were:

- (1) A grid-tied system employing hybrid ZBM-LA storage and a set of algorithms to control power flow (20 units);
- (2) An off-grid solar photovoltaic (PV)-based system also with hybrid storage but using maximum power point trackers (10 units);
- (3) A larger (grid-tied) solar PV-based system three-phase hybrid design again with maximum power point tracking (MPPT) power control (1 unit); and
- (4) Pure ZBM-based systems with algorithmic power control (60 units).

RedFlow's product development investment is ongoing. Our new highly efficient DC/DC converter is anticipated as the next phase of the evolution, resulting in a BMS that will make the flow battery into a standardized plug-and-play product compatible with many existing power systems designed with LA batteries.

## BIOGRAPHICAL NOTE

Steven Hickey received a Bachelor of Electrical Engineering at University of Queensland in 1982. After a brief stint as UQ Energy Management Engineer, he moved to the Julius Kruttschnitt Mineral Research Centre (JKMRC) for the mining research program, working on seismic and blast vibration instrumentation. This experience led in 1988 to his founding (with colleagues) Blastronics Pty. Ltd., which gained an international reputation as a leading consulting and instrumentation business.

Joining RedFlow in mid-2008 as Test Engineer, he is amongst the most senior employees. Recently, he has been responsible for systems design, and for mentoring junior engineers. He currently manages the company's long-term ZBM test program.

